

Compositions and Methods For Cleaning Textile Substrates

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Background of the Invention

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This invention relates to new compositions and methods for cleaning textile substrates, especially carpet and upholstery fabrics. More particularly, this invention relates to liquid compositions that contain absorbent particles in a flowable fluid dispersion, which dries to a soil laden powder, that can be removed by vacuum, brushing, and/or laundering methods. Previous efforts in this area show a continuing need to improve four important features of the textile substrate, especially of the carpet or upholstery cleaning process. These features include: (a) the convenience of applying a cleaning composition, (b) the cleaning efficiency of the cleaning composition, (c) the length of time a cleaned textile is wet, and (d) the reduction of the resoil rate caused by residual surfactant.

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The methods of cleaning of textile substrates may be generally placed into three categories. The first category involves the immersion of the textile into a cleaning solvent followed by agitation and removal of soiled solvent. In this case, water is the preferred solvent, provided that the fiber and/or textile substrate is stable to it. Typically, the additives used to facilitate soil removal by the solvent are surfactants, ionic chelators, and pH adjusters. Other minor ingredients are generally included to enhance the cleaning process. These include fragrances, bleaches, optical brighteners, and anti-resoil ingredients. For example, US Patent Nos. 5,786,317; 6,010,539; and 5,714,449 to 30 Donker, et al., describe a non-aqueous liquid cleaning composition containing solid

particles suspended by the use of hydrophobically modified silica particles. This composition is designed for liquid detergent concentrates for washing machine applications and the particles are active bleaching agents. If the textile is small, this process generally uses standard washing machines or dry cleaning machines to clean the

5 textile. If the textile is large or physically affixed to an object, this process uses portable liquid applicators and vacuum retrieval of the soiled fluid. This method, often referred to as "hot water extraction," applies a substantial amount of water based cleaning solution to the textiles, such as a carpet or upholstery, and uses vacuum extraction to partially remove the soil and surfactant laden cleaning solution. This process typically leaves a

10 residual surfactant on a carpet that attracts dirt to its surface and provides a wet textile that can take many hours to completely dry. The water in the composition is known to cause rust stains if it comes into contact with iron-containing objects, as well as, to provide enhanced growing conditions for mold and other microorganisms. These deficiencies are substantially overcome by low water, powdered cleaning compositions.

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The second general category of methods for cleaning textiles involves applying foam-containing solvents and surfactants to the textile followed by agitation with a brush or damp mop. Typically, the applied foam collapses after contact with the textile, and the spots and soil become less visible. While the appearance on the surface of the textile,

20 such as a carpet, is improved, very little dirt or surfactant is actually removed. The main advantages of this method are the ability to use household tools and equipment and the rapid cleaning cycle. Canadian Patent No. 985113, assigned to Unilever Limited, shows a variation on this wherein a non-scrub foam, which contains soil retardant particles, is applied to the carpet. These soil retardant particles remain as a residue on the carpet

25 after the other components of the foam are removed by vacuuming. While this method

can be used to improve the appearance of a carpet, it is not an effective method of removing dirt and furthermore, it leaves a substantial residue on the carpet.

The third general category of methods of cleaning textiles involves applying a 5 solid composition that contains a solvent and a cleaning surfactant to the textile followed by agitation. Typically, the solvent is allowed to evaporate and the soiled particles are retrieved with a vacuum cleaner or removed by brushing. Powdered cleaning compositions, or other dry-type cleaning compositions, generally contain, in addition to a liquid component and surfactant component, any of a rather wide variety of both natural 10 and synthetic solid particulate materials. Natural solid particulate materials include, for example, buckwheat flour (see US Patent No. 2,165,586 to Studer), wood flour, and diatomaceous earth of specific particle size and low bulk density (see US Patent No. 3,418,243 to Hoxie). Synthetic solid particulate materials include, for example, polymeric 15 materials such as polyurethanes, polystyrenes and phenolformaldehyde resin particles, as disclosed, for example, in French Patent No. 2,015,972. Several examples of powdered cleaning compositions are discussed below.

US Patent No. 4,013,594 to Froehlich, et al. discloses a powdered cleaning composition that contains, as a major component, solid polymeric urea-formaldehyde particles and a 20 solvent component which may be chosen from water, high boiling hydrocarbon or chlorinated hydrocarbon solvents, aliphatic alcohols and mixtures of such compounds.

US Patent No. 4,108,800 to Froehlich discloses a semi-dry powdered cleaning composition which further contains polyethylene glycol as an aid to prevent the adherence 25 of fine particles to the fibers being cleaned. This reference further describes the visual

problem of "frosting" that occurs when small particles are formed from particle to particle attrition as a result of agitation, such as brushing.

US Patent No. 4,194,993 to Deal discloses a process for making a powdered cleaning composition which includes the steps of polymerizing urea and formaldehyde in acidic solution to form particles of a desired size, centrifuging the particles, blending polyethyleneoxide into the polymer, and spraying a fine mist of detergent solution onto the polymer mass as it is blended.

US Patent No. 4,434,067 to Malone, et al. discloses a powdered cleaning composition that contains, in addition to a particulate polymeric material such as urea formaldehyde, an inorganic salt adjuvant and an aqueous or organic fluid component. The Examples and the Tables illustrate that the maximum content of fluid in these powdered cleaning compositions as 40% of the total composition. They further describe the formation of pastes and non-flowable solids when the liquid level or the inorganic salt adjuvant component represents too high a proportion of the total composition.

US Patent No. 4,802,997 to Fox, et al. discloses a polymer gel cleaning composition that may be sprinkled on a carpet wherein the polymer is insoluble in water yet highly swellable with water. This composition is sponge-like in that it is capable of ejecting solvent under mechanical pressure or brushing and then reabsorbing the solvent when the mechanical pressure or brushing is removed. The pea-sized particles can be removed by vacuuming, even if the solvent has not yet evaporated. The polymers suitable for hydrogel formation can absorb 0.3 to 300 times their weight in water. The swollen gels can be blended with calcium carbonate or wood powder to improve flow characteristics.

US Patent No. 4,659,494 to Soldanski, et al. describes a cellulose powder containing dry carpet cleaner with reduced dusting, particularly if the carpet cleaner did not contain added surfactant.

5 US Patent No. 4,908,149 to Moore, et al. discloses improved carpet cleaning compositions that include acid dye stain blocker additives. These compositions range from particle free solutions to dry-type powders with a minimum of 30% solid particle content.

US Patent No. 4,873,000 to Weller discloses a powdered freshening and deodorizing
10 composition for carpets. The composition contains inorganic salts in combination with aluminum silicate clay to improve vacuum retrieval. The composition further contains a maximum of 4% liquid comprised of fragrance and organic agglomerating agent.

EP 1,063,282 B1 to Lang, et al. discloses a cellulose-based, porous, particle gel carpet
15 cleaning composition in combination with water and alcohol. This composition remains in the gel state even in the presence of an 80% water and alcohol mixture.

US Patent No. 5,783,543 to Fleckenstein discloses a scatterable powdered cleaning composition incorporating viscose sponge flakes from 3 to 10 mm in length. The improved
20 composition results in less disruption of the carpet fibers due to the brushing process.

EP 1184449 to Gagliardi, et al. describes a solid cleaning composition with low water content that is particularly useful for cleaning wet spills. The composition incorporates water swellable polymers and anhydrous salts to absorb liquid and turn wet spills into
25 powders that can be removed by vacuum cleaners. The cleaning of wet spills by

conventional powdered cleaning agents is problematic due to the potential to form pastes that are not vacuum retrievable.

US Patent No. 6,569,210 to Chao, et al. describes a novel fabric cleaning method whereby 5 soils are treated with a particulating chemical, such as a colorless sulfonated dye site blocker, to generate particles that are then removed by gas jet interaction.

US Patent No. 6,010,539 to Pesco discloses a modern example of cleaning compositions for hot water extraction systems. This composition is free of organic solvents and contains 10 water, detergent builders (such as sodium tripolyphosphate), EDTA, non-ionic surfactants, stain soluble resist polymers (such as methacrylic acid salts) and a fluorosurfactant.

There have been a few previous attempts by others to create textile cleaning methods and compositions that use liquid or paste systems with particles and solvent. These are briefly 15 described below.

US Patent No. 3,910,848 to Froehlich et al. discloses a cleaning formulation that comprises a halogenated solvent and urea formaldehyde polymer particles as major components. The composition further contains small amounts of an antistatic agent and 20 an anti-settling agent and optionally, a chlorofluorinated propellant for aerosol applications. The high liquid density of the halogenated solvent helps to suspend the particles but its human and ecological impact make it undesirable for consumer use. The reference fails to recommend or suggest the use of water as a solvent.

25 US Patent No. 3,956,162 to Lautenberger describes a thixotropic cleaning paste for cleaning non-horizontal surfaces. The paste contains particles with oil absorption values

above 90, minor amounts of water, both low and high boiling hydrocarbon or halogenated hydrocarbon solvents, surfactant, silica (to provide thixotropic flow characteristics), and various other additives. This composition dries to apparently free flowing particles that can be removed by vacuuming or brushing. This thick composition is not suitable for spraying

5 and contains either the undesirable flammability of hydrocarbon solvents or the undesirable health effects of halogenated solvents.

US Patent No. 4,685,930 to Kasprzak describes a cleaning method of applying liquid cyclic siloxane solvents to soiled textiles and then removing the solvents and dirt by

10 blotting with absorbent paper towels. Alternatively, a solid mixture of cyclic siloxane solvent and an absorbent material selected from mineral particulates, organic particulates, and synthetic porous polymers may be applied to the soiled textile and subsequently removed by brushing or vacuuming. Method claims directed to absorbent particles are limited to cyclic siloxane solvents and stains derived from oil, grease, or sebum.

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US Patent No. 5,259,984 to Hull describes a water-containing polymer cleaning solution that contains a volatile alcohol and a polyamine. This gel or lotion-like solution is spread over the carpet or upholstery, allowed to thicken by evaporation, and then rubbed into soft absorbent polymer gel balls that absorb dirt which may then be removed by brushing or

20 vacuuming. This method seems well suited to rinse-free cleaning of hands, where rubbing and brushing is effective, but is of questionable utility on textile products where the gel may be entrapped within the textile structure and where a fully dried polymer solution may prove intractable.

25 Finally, in US Patent Application No. 2003/0092589 and related US Patent Application No. 2003/0109399 to Todini et al. a liquid nanolatex and surfactant containing composition and

method of cleaning carpets is disclosed. Due to the small size of the nanolatex particles, the particles form suspensions in water. It is further disclosed that upon drying, the nanolatex particles agglomerate and can be removed by vacuum methods. The soil removal index in the table on page 7 of both applications shows several examples of 5 cleaning compositions without illustrating a clear advantage over vacuuming alone.

Thus, as is illustrated by the previous efforts of others, the use of solid cleaning agents for carpet or upholstery has been recognized as the superior method of cleaning. Its low water content allows both for rapid drying and safe cleaning of even expensive 10 wool carpets. The hand application (i.e. sprinkling and spraying methods) and brushing followed by retrieval using the household vacuum cleaner requires no specialized machinery. The particles absorb both sticky soils and residual surfactants so that the textile remains cleaner much longer. In addition, solid cleaning agents have been established to effectively remove allergens, while not promoting the growth of micro- 15 organisms.

There are, however, limitations to the use of solid cleaning agents. The solid cleaning agents may be characterized by the classical Critical Pigment Volume (CPV) effect. The CPV is also known as the oil value, which may be determined by ASTM D281 20 and which is described, for example, in US Patent No. 3,956,162 to Lautenberger. To remain a flowable powder, the maximum liquid content is restricted to below the CPV. For particles of a certain shape, the CPV is the volume between particles filled with air. As the air is displaced by a fluid, the flow properties of the powder are reduced until, at the CPV, all the particles are surrounded by liquid. At that point, the mass has the consistency of 25 putty. If more fluid is added, the putty gradually thins until a paint-like dispersion is generated. The practical problem of prior art solid cleaning compositions is that when wet

spills are cleaned with powdered cleaning agents, it is possible to generate a paste consistency that, when brushed, does not remain free flowing. This creates a spot that is very difficult to remove. In addition, if brushing occurs at the thick dispersion or paste stage the particle size can be mechanically reduced by particle to particle attrition.

5 Particles having a particle size of less than about 5 microns are held very tightly by electrostatic force and are very difficult to remove by vacuum cleaners. This also leads to an observable residual spot of cleaner on the textile. Therefore, there is the need to provide a solid containing cleaning composition that avoids the practical side effects of the Critical Pigment Volume.

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Another limitation of powdered cleaning agents falls into the area of consumer and market perception. Consumers have continued to greatly prefer hot water extraction due to their perception that water and soap are needed to really clean surfaces. Most consumers bathe, clean clothes, clean dishes, and clean hard surfaces with soap and water. There is, therefore, a need to provide a water and soap like cleaning agent without the negative properties of rapid resoil, promotion of microbial growth, and water damage to expensive carpets and other textiles.

Another limitation of powdered cleaning agents and other prior art cleaning methods is the number of steps required to complete the cleaning cycle. For example, the procedure for using the Capture® dry cleaning product, available from Milliken & Company of Spartanburg, SC, includes the steps of: (1) applying a water based premist solution to the carpet, (2) broadcasting the Capture® dry cleaning composition, (3) brushing the cleaning the composition into the carpet, (4) allowing the product to dry for 30 minutes, and (5) retrieving the soil laden powder using a vacuum cleaner. In comparison, the hot water extraction cleaning process preferred by consumers includes the steps of: (1)

compositions. These dry carpet cleaning compositions are typically applied in a liquid form, yet they allow for vacuum removal of absorbent particles that contain oil and water based carpet stains and residual surfactants.

5 The inventive aqueous fluid compositions contain one or more of the following components: organic liquids, absorbent particles, surfactants, surface active agents, dispersion stabilizing additives, static reducing additives, dust suppressing additives, vacuum retrieval additives, metal ion chelators, stain resist agents, pH adjusters, fragrance, biocides, and aerosol propellants. Aerosol propellants may be utilized to assist 10 in providing a cleaning composition that is a stable, sprayable dispersion or that is an easily redispersed (such as by shaking the composition) composition suitable for spraying. These components of the inventive aqueous fluid composition may be present in the inventive composition in any of a number of combinations, as may be determined by the specific end-use of the inventive composition.

15 It may be ideal that the cleaning formulation is comprised of less than about 75 parts by weight of an absorbent particulate and at least about 35 parts by weight water, wherein the water may also contain a surfactant sufficient to provide a surface tension of less than about 40 dynes per centimeter. It may be more preferable that the cleaning 20 composition is comprised of less than about 50 parts by weight of an absorbent particulate. Further, it may be preferable that the cleaning formulation is comprised of at least 50 parts by weight water, and even more preferable, at least 75 parts by weight water, wherein the water may also contain a surfactant sufficient to provide a surface tension of less than about 40 dynes per centimeter. The other various additives and 25 liquids that may be included in the cleaning composition, such as dispersion stabilizers,

vacuum retrieval additives, organic liquids, etc., may be present in amounts from about 0.01 to about 50 parts by weight.

Examples of organic liquids which can be used include, without limitation, C₁ to

- 5 C₄ aliphatic alcohols, high boiling hydrocarbon solvents, and mixtures thereof. The hydrocarbon solvents are generally the petroleum distillates with a boiling point between about 100°C and about 300°C. Low boiling organic liquids are generally unsuitable from a standpoint of vapors and flammability, and higher boiling organic liquids do not evaporate from the carpet fibers at an adequately rapid rate. Examples of commercially available hydrocarbon solvents include Stoddard solvent and odorless hydrocarbon solvent. These solvents usually consist of a petroleum distillate with a boiling point between about 105° and about 200°C. Properties of these solvents are comparable to those of British Standard White Spirits and domestic mineral spirits. Chemically these solvents consist of a number of hydrocarbons, principally aliphatic, in the decane region.
- 10 One potentially preferred, non-limiting organic liquid is a high boiling hydrocarbon solvent.
- 15 One potentially preferred, non-limiting organic liquid is a high boiling hydrocarbon solvent.

The absorbent particles may be selected from a wide variety of solid materials.

- 20 The solid materials may include naturally occurring materials, such as wood particles (like sawdust or wood flour), particles made from grains and other vegetable matter, diatomaceous earth particles, cellulosic particles and inorganic particles (such as silicates, borates, etc.). The solid material may also be a synthetic material, such as a synthetic resin material. Synthetic resin materials include, for example, urea formaldehyde polymer, such as those disclosed in commonly assigned US Patent Nos.
- 25 4,434,067 and 4,908,149. Other synthetic resin materials include, for example,

polyurethane, polystyrene, and phenol-formaldehyde resin particles, similar to the type disclosed in French Patent No. 2,015,972 assigned to Henkel Et Co Gmbh. Still other absorbent particles include water insoluble inorganic salt adjuvants such as, for example, sulfates, carbonates (such as calcium carbonate), borates, citrates, 5 phosphates, metasilicates and mixtures thereof.

Average particle size of the particles may be from about 10 microns to about 300 microns in diameter as determined by sieve analysis. It may be more preferable that the average particle size of the particles is from about 10 microns to about 200 microns in 10 diameter as determined by sieve analysis. It may be even more preferable that the average particle size of the particles is from about 10 microns to about 105 microns in diameter as determined by sieve analysis. It may yet be even more preferable that the average particle size of the particles is from about 35 microns to about 105 microns as determined by sieve analysis. In general, it may be preferable for some applications that 15 the particle size distribution should be such that not more than about 10 percent of the particles are larger than about 105 microns and in general no more than about 5 percent of the particles are smaller than about 10 microns. Larger particles typically do not penetrate carpet material adequately, and use of such particles would result in only superficial cleaning at best. Larger particles also have insufficient surface area to 20 absorb a large amount of soil per unit of weight. If the particles are smaller than about 10 microns in diameter, they may adhere to the individual carpet fibers and have a delustering or dulling effect on the color of the carpet. While particles between about 10 and 35 microns may be tolerated, they may not contribute to cleaning efficiency to any substantial extent so that the average particle size should be in excess of 35 microns.

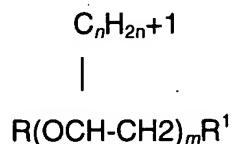
As discussed previously, the absorbent particles may be characterized by the classical Critical Pigment Volume (CPV) effect, also known as the oil value or oil absorption value. This value may be determined by ASTM D281 and is described, for example, in US Patent No. 3,956,162 to Lautenberger. To remain a flowable powder, 5 the maximum liquid content is restricted to below the oil absorption value. For particles of a certain shape, the oil absorption value is the volume between particles filled with air. As the air is displaced by a fluid, the flow properties of the powder are reduced until, at the oil absorption value, all the particles are surrounded by liquid. Accordingly, it may be preferred that the absorbent particles have an oil absorption value of at least 40. It may 10 be more preferable that the absorbent particles have an oil absorption value of at least 60.

One potentially preferred, non-limiting solid material for use in such compositions is the type which has been disclosed in US Patent No. 4,013,594 to Froehlich, et al. 15 wherein particulate, polymeric urea formaldehyde particles were proposed for use in dry-type cleaning compositions. These particulate urea formaldehyde materials were distinguished in the Froehlich patent from those of the earlier French Patent No. 2,015,972 based upon a fairly broad range of parameters. Of particular interest was the disclosure that the particles described in the Froehlich patent, as compared to the 20 particles of the French patent, possessed a somewhat higher bulk density of at least about 0.2 grams per cubic centimeter. Such higher bulk density characteristics resulted in generally increased cleaning effectiveness as compared to the prior art particles.

Surfactants of a number of classes are satisfactory for use in the compositions of 25 this invention. The selection of a surfactant is not critical but the surfactant should serve to lower the surface tension of the water in the composition to about 40 dynes per

centimeter or less. Preferred anionic surfactants are long chain alcohol sulfate esters, such as those derived from C₁₀-C₁₈ alcohols sulfated with chlorosulfonic acid and neutralized with an alkali. Also preferred are alkylene oxide additives of C₆-C₁₀ mono and diesters of ortho-phosphoric acid. Representative nonionic surfactants

5 that can be used have the formula:



10 where n is 0 or 1, m is 3 to 20, R¹ is OH or OCH₃, R is C₁₂ to C₂₂ alkyl or phenyl or naphthyl optionally substituted by C₁ to C₁₀ alkyl groups.

The surfactant can be a nonionic surfactant or a mixture of a nonionic surfactant
15 and either an anionic surfactant or a cationic surfactant. Mixtures of anionic and cationic surfactants are suitable only in carefully selected cases. A preferred composition contains from about 1 to about 4% nonionic surfactant. A satisfactory mixture of commercial anionic surfactants comprises (1) 0.4% of the sodium salt of a mixture of C₁₀-C₁₈ alcohol sulfates, predominantly C₁₂, (2) 0.4% of the diethylcyclohexylamine salt
20 of the same sulfate mix, and (3) 0.2% of the product formed by reacting a mixture of n-octyl mono and diesters of ortho-phosphoric acid with sufficient ethylene oxide to form a neutral product, ordinarily about 2 to 4 moles of ethylene oxide per mole of phosphoric ester. The surfactant is normally used in amounts ranging from about 0.5 to about 5.0% by weight but useful amounts are not limited to this range.

25 Examples of dispersion stabilizing additives include, for example, such compounds as air, cellulosic polymers (such as hydroxyethylcellulose), starches, clay

compounds, xanthan gums, polyacrylic acids and esters (such as methacrylic acid/ethyl acrylate copolymer), polyacrylamide, polyvinyl alcohol and mixtures thereof.

Vacuum retrieval additives include, for example, compounds such as

5 polyoxyalkylene materials (such as dipropylene glycol), aluminum silicate clay, hydrolyzed styrene maleic anhydride, and mixtures thereof. Polyoxyalkylene materials (such as dipropylene glycol, as well as non-volatile organic solvents (such as mineral oil), and mixtures thereof may also be used as dust suppressing additives. Aluminum silicate clay may also be used as a static reducing additive. Metal ion chelators include

10 such compounds, for example, as ethylene diamine tetraacetic acid (EDTA). Stain resist agents include such compounds as, for example, acrylic stain blockers. Such compounds as aqua ammonia and citric acid may be included as pH adjusters. Biocides may be included to prolong the shelf life of the cleaning composition. These may include, for example, compounds such as potassium sorbate, isothiazolones and

15 mixtures thereof. Aerosol propellants include such compounds as propane, butane, carbon dioxide and mixtures thereof.

The textile substrate to which the composition may be applied is most preferably a carpet or upholstery fabric. As used herein, the term "carpet" is intended to include,

20 without limitation, broadloom carpets, carpet tiles, rugs, and other textile floor covering material that may be cleaned by the compositions and methods described herein. The upholstery fabric may be woven, knitted, nonwoven, or combinations thereof. The textiles substrates may be comprised of natural fibers, synthetic fibers, or combinations thereof. Synthetic fibers include, for example, polyester, acrylic, polyamide, polyolefin,

25 polyaramid, polyurethane, regenerated cellulose, polyvinylacetate, and blends thereof. More specifically, polyester includes, for example, polyethylene terephthalate,

polytriphenylene terephthalate, polybutylene terephthalate, polylactic acid, and combinations thereof. Polyamide includes, for example, nylon 6, nylon 6,6, and combinations thereof. Polyolefin includes, for example, polypropylene, polyethylene, and combinations thereof. Polyaramid includes, for example, poly-*p*-

5 phenyleneteraphthalamid (i.e., Kevlar®), poly-*m*-phenyleneteraphthalamid (i.e., Nomex®), and combinations thereof. Natural fibers include, for example, wool, cotton, flax, and blends thereof.

The textile substrate may be formed from fibers or yarns of any size, including

10 microdenier fibers and yarns (fibers or yarns having less than one denier per filament). The fabric may be comprised of fibers such as staple fiber, filament fiber, spun fiber, or combinations thereof.

The cleaning composition may be applied to a carpet using a trigger, pump, or

15 electrical sprayer, wherein said electrical sprayer is battery or power operated. This method may be well suited for spot cleaning a textile substrate. The term "spray application" or "spray-applied" is intended to encompass the application of such compositions to target fabrics through the utilization of a spray-trigger mechanism and/or device as is well known in the art. The cleaning composition may be dispensed as a

20 continuous stream or as a spray of droplets. Such a mechanism and/or device provides an effective manner of uniformly dispersing droplets of the composition over a relatively broad surface area of a target substrate. Thus, atomization, droplet formation and application on an even basis, and other non-limiting and similar spraying techniques are encompassed by such a term. It is also contemplated that the cleaning composition could

25 be poured from the spray bottle to clean a textile substrate.

There are various well-known types of sprayers available, and several examples are disclosed in the Examples section below. Some are known as finger sprayers, which may have a spray orifice of about 0.1 mm to about 0.8 mm in diameter. Others, such as trigger sprayers, may have a spray orifice of about 0.4 mm to about 1.0 mm in diameter.

5 Common pump up and electric sprayers may have a spray orifice measuring, on average, 0.02 inches in diameter. The method itself may also require a simple agitation, such as by rubbing or brushing, of the target fabric surface after spray application in order to work the composition into the soiled substrate surface. The cleaning composition may then be retrieved from the substrate either by immediate vacuuming or by a later vacuuming.

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Alternatively, the cleaning composition may be applied to the textile substrate via a squeezable packaging container. This method may also be well suited for spot cleaning a textile substrate. The size of the container may be such that the interior volume of the container will typically hold less than about one gallon of cleaning composition. Such a container may have a removable screw cap or a flip cap at one end for dispensing the cleaning composition. The cap may also have a synthetic applicator tip at one end comprised of a plurality of synthetic bristles, foam, or other scrubbing mechanism. A synthetic cover may also be provided which serves to encase the applicator tip when not in use. The applicator tip may have an opening which allows the cleaning composition to be dispensed from within the container when pressure is applied to the container. The opening may have a diameter of about 0.5 mm to about 5.0 mm. Once the cleaning composition has been applied to the textile substrate, the bristles of the applicator tip may serve as an agitating tool for brushing or rubbing the composition into the soiled textile substrate surface. As in the spray application method, the cleaning composition may then be retrieved from the substrate either by immediate vacuuming or by a later vacuuming.

Yet another application method includes applying the cleaning composition to a textile substrate, particularly a carpet or upholstery fabric, using a carpet cleaning machine. The carpet cleaning machine may be a hot water extraction machine, a 5 bonnet machine, or a foaming machine. The carpet cleaning machine may be electrical powered, battery powered, or it may be a mechanical carpet cleaning device that is powered by human effort similar to a kitchen mop. This application method may be well suited for residential or commercial carpet cleaning needs. The cleaning composition may be contained in a holding tank that is mounted on the vertical handle of a traditional 10 carpet cleaning machine. The holding tank may include a stirring mechanism inside the tank which allows for continuous stirring of the composition contained therein. A dispensing lever, attached to the horizontal handle of the machine, may be used to dispense the cleaning composition from the holding tank. Suitable tubing materials may be used which is connected to an opening in the bottom of the holding tank and extends 15 vertically downward to the rotating brushes located on the bottom of the carpet cleaning machine.

The cleaning composition, when mechanically released from the holding tank by the dispensing lever, enters the tubing at this opening and, due to gravity, descends 20 downward to the scrubbing mechanism located on the underside of the carpet cleaning machine. The scrubbing mechanism for electrical or battery powered machines may include rotating brushes. The scrubbing mechanism for the mechanical, mop-like cleaning machines may include abrasive foam sponges or other any other material which will act as to work the cleaning composition into the soiled surface. The cleaning 25 composition descends downward to the scrubbing mechanism until the tubing terminates and the cleaning composition is dropped onto the substrate. The rotating brushes will

then gentle work the composition into the soiled surface of the substrate, and then the composition may be retrieved immediately or at a later time via vacuuming.

Various embodiments of the invention are shown by way of the Examples below,

5 but the scope of the invention is not limited by the specific Examples provided herein.

EXAMPLES

The following Examples further illustrate the present cleaning formulation but are not to be construed as limiting the invention as defined in the claims appended hereto.

10 All parts and percents given in these examples are by weight unless otherwise indicated.

Textile Substrates:

Various carpet and fabric substrates, as described below, were used to test the inventive cleaning compositions and methods.

15 *Carpet A-1:*

This carpet is a dark blue color commercial grade 18"cut pile carpet tile (available from Milliken & Company of Spartanburg, SC, Pattern # 542903). The carpet was a cushion back construction of 100% nylon face fiber.

Carpet A-2:

20 This carpet is a light tan commercial grade 18"cut pile carpet tile (available from Milliken & Company of Spartanburg, SC, Pattern # 542903). The carpet was a cushion back construction of 100% nylon face fiber.

Carpet B:

25 This carpet is an off white residential top grade broadloom carpet (available from Shaw, Profusion product). The carpet was constructed of 100% nylon face fiber. The carpet had a fluorocarbon treatment on its surface.

Carpet C:

This carpet was an almond colored builder grade broadloom carpet (available from Mohawk, Commander product). The carpet was constructed of 100% nylon face fiber. The carpet had no fluorocarbon treatment on its surface.

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Carpet D:

This carpet was a dark blue commercial grade 18"cut pile carpet tile (available from Milliken & Company, Pattern # 542903). The carpet was a cushion back construction of 100% nylon face fiber.

Carpet E:

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This carpet was a white, cut loop pile broadloom carpet (available from Milliken & Company). The carpet was comprised of 100% nylon face fiber.

Fabric A:

This fabric was a 100% cotton oxford flat weave fabric (available from Milliken & Company).

15

Examples 1-9:

Various liquid carpet cleaning compositions containing particles suspended in a solvent, in a slurry form, were produced for cleaning residential and commercial carpet substrates. The formulations and procedures are described below.

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I. Formulations

Example 1:

The formulation was prepared by placing 30 parts of water and a blend of the 25 remaining 60 parts of the other "dry" ingredients (listed below in Table 1) into the stainless steel bowl of a KitchenAid ProLine mixer having the whisk attachment in place.

The mixer was turned to a setting of 2 and allowed to run for 2 minutes. The result was a stable, frothy foam.

Carpet A-2 was spot stained according to the Spot Cleaning Test Procedure described 5 below. The formulation of Example 1 was then applied to Carpet A-2. The stable, frothy foam remained on the surface and was easily hand brushed into the carpet. The results showed that, by visual evaluation, the formulation of Example 1 removed the 10 stain spots when compared with the control carpet. The results also indicate that air may be incorporated into the cleaning formulation as a dispersion stabilizing additive, via a wire whisk attachment on a mixer, to create a foam that can then be transferred to a 15 textile substrate for cleaning purposes.

Table 1 – Example 1 Formulation

	<u>Component</u>	<u>Amount (parts)</u>
15	Urea Formaldehyde Polymer ("UFP", as described in US Patent No. 3,910,848) (35-40% moisture content)	44
	Calcium Carbonate (inorganic salt)	21
	Water	30.4
	Triton XL 80 N (a nonionic surfactant available from Rohm and Haas)	2.4
20	MilliGard NYS (an acrylic stain resist agent available from Milliken Chemical)	1.0
	Potassium Sorbate (a biocide)	1.0
25	Kathon (an isothiazolone biocide available from Rohm and Haas)	0.1
	Fragrance	0.1

Example 2:

The formulation was prepared according to the same procedure described previously in Example 1 using the components shown below in Table 2.

5 Carpet A-2 was spot stained according to the Spot Cleaning Test Procedure described below. The formulation of Example 2 was then applied to Carpet A-2. The stable, frothy foam remained on the surface and was easily hand brushed into the carpet. The results showed that, by visual evaluation, the formulation of Example 2 removed the stain spots when compared with the control carpet. The results also indicate that air
10 may be incorporated into the cleaning formulation as a dispersion stabilizing additive, via a wire whisk attachment on a mixer, to create a foam that can then be transferred to a textile substrate for cleaning purposes.

Table 2 – Example 2 Formulation

	<u>Component</u>	<u>Amount (parts)</u>
	UFP (35-40% moisture content)	44
	Calcium Carbonate (an inorganic salt)	21
15	Water	31.2
	Triton XL 80 N (a nonionic surfactant)	2.4
20	Potassium Sorbate (a biocide)	1.0
	Kathon (a biocide)	0.1

Example 3:

The formulations for Examples 3A - 3E were prepared following the procedure for
25 Example 1 using the components shown in Table 3 below. The mixer was turned to a setting of 2 and allowed to run for 2 minutes. The result was a stable, frothy foam.

Example 3F was also prepared following the procedure for Example 1 using the components shown in Table 3 and by using a stream of air, instead of a whisk, to incorporate air into the formulation as a dispersion stabilizing additive and generate the

5 foam. The resulting foam flowed over the walls of the container. The foam was stable for several minutes before collapsing. After the foam collapsed and dried, there was residual powder present that confirmed that the powder could be transported from a tank and delivered to a textile substrate surface (such as a carpet) by a foaming mechanism.

10 Carpet A-2 was spot stained according to the Spot Cleaning Test Procedure described below. The formulations of Examples 3A-3E were then applied to Carpet A-2. The stable, frothy foam remained on the surface and was easily hand brushed into the carpet. The results showed that, by visual evaluation, the formulations of Examples 3A-3E removed the stain spots when compared with the control carpet.

15

Table 3 – Example 3 Formulations (Amounts are in parts)

Component	3A	3B	3C	3D	3E	3F
UFP (35-40% moisture content)	39.5	39	40	42.4	25.8	17
Water	49.5	49.5	50	57.4	72.9	82
MilliGard NYS (an acrylic stain resist agent)	10	10	0.8	0	1.0	0.8
Triton XL 80 N (a nonionic surfactant)	1	0	0.2	0.2	0.3	0.2
Sodium Lauryl Sulfate (an anionic surfactant)	0	1.5	0	0	0	0

Example 4:

The formulation was prepared by placing water and a blend of the remaining parts of the other "dry" ingredients (listed below in Table 4) into the stainless steel bowl

of a KitchenAid ProLine mixer having the kneading attachment in place. The mixer was turned to a setting of 2 and allowed to blend the ingredients for 5 minutes. Then 20 parts of Example 4 was packaged with 80 parts of water into an aerosol can having a propane/butane mixture as the propellant. When the solution was discharged from the 5 can onto the surface of a carpet the resulting foam did not collapse until after 2-3 minutes had elapsed.

Carpet B was spot stained according to the Spot Cleaning Test Procedure described below. The formulation of Example 4 was then applied to Carpet B. The stable, frothy 10 foam remained on the surface and was easily hand brushed into the carpet. The results showed that, by visual evaluation, the formulation of Example 4 removed the stain spots when compared with the control carpet. The results also show that including an aerosol propellant in the formulation is an effective means of creating a dispersion which could be easily applied to the surface of a textile substrate.

15

Table 4 – Example 4 Formulation

<u>Component</u>	<u>Amount (in grams)</u>
UFP (35-40% moisture content)	55.5
Water	44.4
20 Erionyl NYB (an acrylic stain blocker)	0.09
Hydroxy Ethyl Cellulose (a dispersion stabilizing additive)	0.01

Example 5:

The formulations for Examples 5A - 5D were prepared by adding the appropriate 25 amount of water and other liquid ingredients, as shown in Table 5 below, into a breaker equipped with a magnetic stir bar. Once the solution was allowed to stir, the remaining

ingredients were added and agitated for 2 minutes. The particles quickly settled out of solution over a 1-2 minute period.

Carpet A-2 was tested for cleaning efficiency according to the Cleaning Efficiency Test

5 Procedure described below. The formulations of Examples 5A-5D were then applied to Carpet A-2 using a trigger sprayer (Calmar item # TS 800, AFA Dispensing Co Ratchett QAIII, AFA Dispensing Co. item # 5910BT) while the solution was continuously stirred. A stable dispersion was formed and was easily hand brushed into the carpet. The cleaning efficiency results of each of the formulations was compared with: (a) samples 10 treated with water only ("Control"), (b) samples cleaned using Capture powder and Pre-Mist Spray (both available from Milliken & Company), and (c) samples treated with a Hoover Steam Vac Prosteam carpet cleaning machine and the cleaning chemicals recommended for use in the machine (performed according to AATCC 171-97 Test Method for hot water extraction of cleaning carpets). The results are shown in Table 5R- 15 1 below.

The formulation of Example 5C was also applied to Carpet B and Carpet C. The

cleaning solution was applied to the carpet using the Calmar trigger sprayer while the 20 solution was continuously stirred. The results showed that, by visual evaluation, the formulation of Example 5C removed the stain spots when compared with the control carpet.

The formulation of Example 5C was also applied to Carpet C using an Aerus Floor Pro

Encore Shampooer/Polisher machine which gravity fed the solution to the carpet while

25 the dispersion was continuously circulated in a holding tank attached to the handle of the machine. Subsequent testing of the carpet was performed according to the Cleaning

Efficiency Test Procedure; however, the results were rated using the visual analysis technique for the Spot Cleaning Test Procedure. The results are shown in Table 5R-2 below.

- 5 The formulation of Example 5C was also applied to Carpet B and Carpet C using a Hoover Steam Vac Prosteam carpet cleaning machine while the solution was continuously circulated in the holding tank. The results showed that, by visual evaluation, the formulation of Example 5C removed the stain spots when compared with the control carpet. The results also indicate that the inventive cleaning compositions
- 10 may successfully be applied to a textile substrate via a carpet cleaning machine.

Table 5 – Example 5 Formulations (Amounts are in parts)

Component	5A	5B	5C	5D
UFP (dry weight)	2.00	10.00	20.00	40.00
Water	96.829	88.956	79.084	59.262
Styrene Maleic Anhydride (vacuum retrieval additive)	0.88	0.79	0.692	0.558
Aqua Ammonia (pH adjuster)	0.02	0.016	0.014	0.011
Sodium Lauryl Sulfate (an anionic surfactant)	0.20	0.172	0.152	0.122
Propylene Glycol t-butyl ether (an organic liquid)	0.07	0.065	0.057	0.046
Fragrance	0.001	0.001	0.001	0.001

Table 5R-1: Example 5 Cleaning Efficiency Results

Sample	Amount of Formulation Added to Tile (g)	Ls After Soiling	Lo Original	Lc After Cleaning	% Cleaning Efficiency	Average % Cleaning Efficiency
Control 1	1.42	55.855	60.644	57.699	38.50	
Control 2	1.62	55.204	60.62	57.19	36.67	
Control 3	1.61	54.77	60.157	56.781	37.33	38
Example 5A-1	1.47	55.735	60.2	58.546	62.96	
Example 5A-2	1.57	55.995	60.52	58.698	59.73	
Example 5A-3	1.73	56.19	60.537	58.667	56.98	60
Example 5B-1	1.59	55.565	60.608	58.741	62.98	
Example 5B-2	1.62	55.474	60.672	58.13	51.10	
Example 5B-3	1.54	55.367	60.141	58.244	60.26	58
Example 5C-1	1.52	55.454	60.553	59.086	71.23	
Example 5C-2	1.52	55.015	60.828	58.965	67.95	
Example 5C-3	1.51	54.925	60.529	58.686	67.11	69
Example 5D-1	2.08	55.417	60.33	58.876	70.41	
Example 5D-2	1.42	55.027	60.644	58.782	66.85	
Example 5D-3	1.42	54.89	60.675	59.14	73.47	70
Capture® Powder and Pre-Mist Spray 1	N/a	55.232	60.35	59.193	77.39	
Capture® Powder and Pre-Mist Spray 2	N/a	55.505	60.445	58.354	57.67	
Capture® Powder and Pre-Mist Spray 3	N/a	54.874	60.251	57.674	52.07	62
Hoover Steam Vac 1	2.15	54.762	60.492	56.067	22.77	
Hoover Steam Vac 2	0.82	54.837	60.535	56.052	21.32	
Hoover Steam Vac 3	1.25	54.648	60.263	55.686	18.49	21

5 "N/a" indicates that data was not available.

The test results above indicate that these inventive cleaning compositions, while requiring continuous stirring or circulation, clearly provide greater average cleaning efficiency for a textile substrate, such as a carpet, when compared with other commercially available cleaning compositions and methods. The comparative

5 compositions include both dry (Capture® Powder) cleaning compositions and hot water extraction cleaning systems (Hoover Steam Vac). The results also indicate that the inventive cleaning compositions provide far superior average cleaning efficiency for a textile substrate, such as a carpet, when compared with hot water extraction cleaning systems (Hoover Steam Vac).

10

Table 5R-2: Example 5 Cleaning Results

Sample	Visual Evaluation	Average of Visual Evaluation Results
Example 5C in Aerus machine –1	3.5	
Example 5C in Aerus machine – 2	3.5	
Example 5C in Aerus machine –3	3.5	3.5
Hoover Steam Vac – 1	3.1	
Hoover Steam Vac – 2	3.1	
Hoover Steam Vac – 3	3.1	3.1
Capture® Powder & Premist Spray – 1	3.0	
Capture® Powder & Premist Spray – 2	3.0	
Capture® Powder & Premist Spray – 3	3.0	3.0

15 The results showed that, by visual evaluation, the formulation of Example 5C removed the stain from the soiled carpet much better than the Capture® Powder & Premist Spray

combination. The formulation performed slightly better than the hot water extraction system (using a Hoover Steam Vac machine with the recommended Hoover chemicals). The results also indicate that the inventive compositions may successfully be applied to a soiled textile substrate via a carpet cleaning machine.

5

Example 6:

The formulations for Examples 6A - 6D were prepared by adding the appropriate amount of water, as shown in Table 6 below, into a breaker equipped with an overhead 10 stir motor with a Cowles blade attached. The agitator was adjusted to 500-700 rpm. The Laponite RD was slowly charged over a 10 minute period. The solution was heated to 50-60 degrees C and Pluronic L65 LF was slowly added over a 10 minute period. The heat source was turned off and the UFP was slowly added over a 15-20 minute period. The resulting mixture was a stable dispersion wherein the particles did not settle out 15 over a period of time from between 2-3 hours and up to several days. Therefore, the solutions did not require continuous agitation to prevent the particles from settling. The formulations were sprayable through both ordinary and commercially available trigger (Calmar sprayer, described previously) and finger sprayers (available from Seaquist, Sea Spray sprayer).

20

Carpet B was spot stained according to the Spot Cleaning Test Procedure described below. The formulation of Example 6B was then applied to Carpet B. The results showed that, by visual evaluation, the formulation of Example 6B removed the stain spots when compared with the control carpet.

25

Table 6 – Example 6 Formulations (Amounts are in parts)

Component	6A	6B	6C	6D
UFP (dry weight)	15	15	15	15
Water	82.5	82.0	81.5	81.0
Laponite RD (clay dispersion stabilizing additive)	1.0	1.5	2.0	2.5
Pluronic L65 LF (surfactant)	1.5	1.5	1.5	1.5

5 Example 7:

The procedure for Example 6 was followed to create the formulations for Examples 7A – 7G. Examples 7D - F include commercially available carpet cleaning particles in the formulations. The components for each Example are shown below in 10 Table 7. The formulations of Examples 7A-7G formed stable dispersions that were easily hand brushed into a carpet.

Carpet A-2 was tested for cleaning efficiency according to the Cleaning Efficiency Test Procedure described below. The formulations of Examples 7A-7G were then applied to 15 Carpet A-2 using a flip cap lotion bottle. The cleaning efficiency results of each of the formulations was compared with a sample treated with Capture® powder. The results are shown in Table 7R below.

Table 7 – Example 7 Formulations (Amounts are in parts)

Component	7A	7B	7C	7D	7E	7F	7G
UFP (dry weight)	15	0	0	0	0	0	0
Water	82	82	82	82	82	82	82
Laponite RD (clay dispersion stabilizing additive)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Pluronic L65 LF (surfactant)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Calcium Carbonate (an inorganic salt)	0	15	0	0	0	0	0
SolkaFloc 100 (cellulosic particles)	0	0	15	0	0	0	0
Host white (cellulosic particles)	0	0	0	15	0	0	0
Resolve® High Traffic (cellulosic particles)	0	0	0	0	15	0	0
Duo P (a European particulate urethane foam)	0	0	0	0	0	15	0
Diatomaceous earth particles	0	0	0	0	0	0	15

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Table 7R – Example 7 Cleaning Efficiency Results

Sample	Amount of Formulation Added to Tile (g)	Ls After Soiling	Lo Original	Lc After Cleaning	% Cleaning Efficiency	Average % Cleaning Efficiency
Capture® powder 1	4.33	54.203	63.819	59.349	53.51	
Capture® powder 2	4.02	54.236	64.159	58.986	47.87	
Capture® powder 3	4.13	54.379	63.861	59.281	51.70	51
Example 7A-1	4.35	54.596	64.129	59.11	47.35	
Example 7A-2	4.52	55.639	64.631	60.44	53.39	
Example 7A-3	4.44	55.265	64.393	59.606	47.56	49
Example 7B-1	4.11	55.337	64.546	59.523	45.46	
Example 7B-2	4.26	54.886	64.11	60.024	55.70	
Example 7B-3	4.32	55.946	64.461	60.715	56.01	52
Example 7C-1	4.36	56.218	64.226	63.192	87.09	
Example 7C-2	4.28	56.542	64.241	62.798	81.26	
Example 7C-3	4.31	56.659	64.39	63.228	84.97	84
Example 7D-1	4.40	55.946	64.441	62.443	76.48	
Example 7D-2	4.44	55.404	64.275	62.411	78.99	
Example 7D-3	4.52	55.851	64.303	63.012	84.73	80
Example 7E-1	4.08	55.978	64.349	56.75	9.22	
Example 7E-2	4.21	56.181	64.491	57.368	14.28	
Example 7E-3	4.13	55.992	64.421	56.989	11.83	12
Example 7F-1	4.09	55.132	64.14	57.22	23.18	
Example 7F-2	4.40	56.083	64.366	58.379	27.72	
Example 7F-3	4.48	56.146	64.452	58.472	28.00	26
Example 7G-1	4.08	55.792	64.226	60.232	52.64	
Example 7G-2	4.22	55.616	64.266	61.207	64.64	
Example 7G-3	4.35	56.3	64.287	62.614	79.05	65

The test results above indicate that the inventive cleaning compositions very good average cleaning efficiency for a textile substrate, such as a carpet, when compared with other commercially available cleaning compositions and methods. The comparative compositions include both dry (Capture® Powder) cleaning compositions and liquid formulations containing competitive carpet cleaning products, such as Resolve® High Traffic and Duo P. Without being bound by theory, it is believed that the formulations of Examples 7C and 7D performed so well due to the highly absorbent nature of the particles included in the formulations and the resulting ability to absorb more of the stain from the substrate. Further, and without being bound by theory, it is believed that the formulations of Examples 7E and 7E may have performed less optimally due to large particle size of the particulate material used in the formulations. These large particles likely have less surface area for absorbing stain from the substrate, thereby providing less cleaning efficiency.

15

Example 8:

The procedure for Example 6 was followed to create the formulations for Examples 8A – 8D. The components for each Example are shown below in Table 8. The formulations for Examples 8A-8D formed stable dispersions that were easily hand brushed into a carpet.

20

Carpet A-2 was spot stained according to the Spot Cleaning Test Procedure described below. The formulations of Examples 8A-8D were then applied to Carpet A-2. A white towel was used to hand brush Examples 8A-8D, while a Capture® brush was used to hand brush the comparative Capture® powder. Hot water extraction ("HWE") was also performed on a comparative example using a Hoover Steam Vac Prosteam carpet

cleaning machine, according to AATCC 171-97 Test Method for hot water extraction of cleaning carpets. The results are shown in Table 8R below.

Table 8 – Example 8 Formulations (Amounts are in parts)

Component	8A	8B	8C	8D
UFP (dry weight)	15	15	15	15
Water	80.5	75.2	75.2	75.2
Laponite RD (clay dispersion stabilizing additive)	1.5	1.5	1.5	1.5
Pluronic L65 LF (surfactant)	1.5	1.5	1.5	1.5
Dipropylene Glycol (a vacuum retrieval additive)	1.5	1.5	1.5	1.5
Ethanol (an organic liquid)	0	2.3	0	0
Isopropyl Alcohol (an organic liquid)	0	0	2.3	0
Mineral Oil (a dust suppressing additive)	0	0	0	2.3

Table 8R – Example 8 Spot Cleaning Results

Sample	Spotting Substance										Average
	Lipstick	French Salad Dressing	Ketchup	Cola	Shoe Polish	Grape Juice	Chocolate	Motor Oil	Butter	Coffee with cream & sugar	
Ex. 8A	1	1	2	2	2.4	1	1	2	1	1.6	1.5
Ex. 8B	2	1	1	1.8	1.8	1	1	1	1	1.4	1.3
Ex. 8C	2	1	1	1	2.4	1	1	1	1.6	1.6	1.36
Ex. 8D	2	1	1	1	2.4	1	1	2	1.6	1.4	1.44
Capture Powder	3	1.8	3	1	2	1.4	2.2	3	2	1	2.04
HWE	5	5	5	4.8	4.4	4.6	4.4	5	3.8	2.4	4.44

The results show that all of the inventive formulations 8A-8D performed very well in removing the stains (lower values illustrate more complete stain removal). The 5 inventive formulations each exhibited approximately the same degree of removal of the stains. However, there was a noticeable difference in the removal of the French salad dressing stain. The formulations containing ethanol (Example 8B), isopropyl alcohol (Example 8C), and mineral oil (Example 8D) totally removed the French salad dressing stain, thereby illustrating, for example, the benefit of including an organic liquid in the 10 cleaning composition. Capture® powder did not remove the stains as well as the inventive formulations. The hot water extraction performed poorly, with little to no stain removal.

Example 9:

The procedure for Example 6 was followed to create the formulations for Examples 9A – 9F. The components for each Example are shown below in Table 9. The formulations of Examples 9A-9F formed stable dispersions that were easily applied 5 to a carpet.

The formulations of Examples 9A-9F were applied to Carpet A-1 according to the Dusting Test Procedure described below to compare the amount residual dust or powder left after cleaning the carpet (often known as “frosting”). The results are shown in Table 10 9R below.

Table 9 – Example 9 Formulations (Amounts are in parts)

Component	9A	9B	9C	9D	9E	9F
UFP (dry weight)	15	15	15	15	15	15
Water	82	81.85	81.25	79.75	77.5	75.25
Laponite RD (clay dispersion stabilizing additive)	1.5	1.5	1.5	1.5	1.5	1.5
Pluronic L65 LF (surfactant)	1.5	1.5	1.5	1.5	1.5	1.5
Dipropylene Glycol (a vacuum retrieval additive)	0	0.15	0.75	0	0	0
Pyrax WA (aluminum silicate clay, a vacuum retrieval additive)	0	0	0	2.25	4.5	6.75

Table 9R – Example 9 Dusting Test Results

Sample	Lo Value	Lc Value	Dusting Level	Average of Dusting Level Values
Example 9A	15.636	18.894	3.258	
	15.092	18.382	3.29	
	15.961	18.173	2.212	2.92
Example 9B				
	15.922	17.296	1.374	
	16.052	16.62	0.568	
Example 9C	15.02	15.832	0.812	0.92
Example 9D	15.713	16.559	0.846	
	15.409	16.268	0.859	
	15.22	16.277	1.057	0.92
Example 9E				
	15.097	17.837	2.74	
	15.35	17.994	2.644	
Example 9F	16.117	18.462	2.345	2.58
Example 9E	16.02	18.425	2.405	
	15.872	18.505	2.633	
	16.012	18.157	2.145	2.39
Example 9F				
	15.362	19.581	4.219	
	15.751	19.66	3.909	
	15.81	18.59	2.78	3.64

The results indicate that using a vacuum retrieval additive in the inventive
 5 cleaning formulation may reduce the amount of cleaning composition that remains on
 the textile substrate after removal by vacuuming (lower number indicates less cleaning
 composition left behind on the carpet). More specifically, dipropylene glycol appears to

be a preferred retrieval additive when compared with aluminum silicate clay. The results also show that adding more vacuum retrieval additive to the formulation does not necessarily achieve a higher rate of retrieval. Thus, this Example illustrates that by including a vacuum retrieval additive in the cleaning composition, the amount of cleaning 5 composition removed from the substrate may be increased. In turn, the amount of cleaning composition that is left on the substrate is reduced. This is advantageous because the lowering the amount of residual cleaning compositions left on the substrate will reduce the textile substrate resoil rate.

10 II. Test Procedures and Discussion of Results

Spot Cleaning Test Procedure

15 This procedure was used to determine the effectiveness of various carpet cleaners to remove common household stains from carpet. This method also provided a way to compare different cleaners in their ability to remove stains.

Procedure

20 1. The carpet specimen was cut into pieces 10" x 13." One 10" x 13" piece was used to test up to ten stains per cleaner. Enough pieces were cut to test all cleaners on each stain to be evaluated plus one additional sample was cut for use as a control. For example, to test 12 cleaners on each of 10 stains, 13 of the 10" x 13" pieces were needed.

25 2. The ten stains were placed on each carpet piece using a standard carpet staining technique. Each staining material was applied to each piece of carpet. The typical household stains that were tested were: lipstick, French salad dressing,

ketchup, cola, shoe polish, grape juice, chocolate, motor oil, butter and coffee (cream & sugar). Stains are allowed to dry overnight after applying to the carpet.

3. One stain blanket to be cleaned by each cleaner was labeled. A Sharpie marker was used to label the backs of each stain blanket with the designated carpet cleaner. A code was used for each cleaner so that the evaluation will not be biased. One stain blanket was not cleaned and was used as a control to compare the effectiveness of each cleaner on stain removal.
- 10 4. Each stain was cleaned with the designated cleaner according to the package instructions (if commercial product) and allowed to dry overnight.
- 15 5. Five people, not involved in this project, were used to rank the residual stains after cleaning ranking from best to worse with 1 being the best. Rating: 1 = completely removed, 2 = very good (acceptable), 3 = pretty good (borderline), 4 = poor (unacceptable), 5 = nothing removed (same as original).
- 20 6. The rankings were then averaged by cleaner and by stain. In some instances, only a visual notation was made to indicate whether the stains were removed in comparison to the control sample.

Cleaning Efficiency Test Procedure

This procedure was used to compare the cleaning ability (efficiency) of carpet cleaners using a standard soil in order to mimic carpet soiled by foot traffic.

Light colored carpet tiles (available from Milliken & Company of Spartanburg, SC,
Pattern # 542903)

3M Soil

CSI Tumbler and Soil Bomb

5 Analytical balance

Top-loading balances

GLS scrubbing Machine, Whittaker

Windsor vacuum cleaner

GretagMacbeth Color-Eye7000A Colorimeter

10

Preparation

1. A clicking machine was used to cut 4 1/2" x 4 1/2" pieces of light tan commercial grade 18"cut pile carpet tile. Each product or formulation tested was run in triplicate.
- 15 2. A template was prepared by clicking a 4 1/2" x 4 1/2" piece from the center of a tile. 1/8" of carpet was trimmed from the inside edges of the hole in the template to allow for a good fit.
3. Another whole tile was taped to the bottom edge of the template.

20

Procedure

1. A 4 1/2" x 4 1/2" piece of tile was placed into the hole in the template.
2. The GLS machine was used to make 2 passes (up and back) over the template and test carpet.
- 25 3. The Windsor vacuum was used to make 5 passes over the template and test carpet. Going up and back is considered one pass.

4. Steps 1-3 were repeated for each carpet piece.
5. The LAB values of each carpet piece was measured on the Color-Eye. This reading was recorded as "Lo."
6. 1.5g of 3M soil was added to the soil bomb.
- 5 7. Four of the prepared test carpet pieces were placed on the Soiling Tumbler and the soil bomb was added.
8. Samples were tumbled for 30 minutes.
9. Carpet pieces were removed from the tumbler, and vacuum as in step #3.
10. The LAB values were measured on the Color-Eye; these values were called "Ls." Ls values must be within +/- 3% (ex: Ls=42.0 +/- 1.3). Soiled pieces outside the proper range were not used.
11. Each tile was soiled, vacuumed and the LAB values were measured for all test carpet pieces as in steps 6-10.
12. The cleaning composition was then applied to the soiled carpet as described for each specific Example above.
13. The piece of carpet was then placed in the template.
14. The cleaning composition was scrubbed into the carpet using 3 passes with the GLS.
15. The carpet was removed from the template and was set aside to dry.
- 20 16. The empty template was vacuumed as in Step 3 above.
17. Steps 12-16 were repeated until all samples had been scrubbed.
18. When the cleaning composition had dried for 30 minutes (or the desired drying time), each piece was placed into the template and 5 passes were made with the Windsor vacuum.
- 25 19. The pieces were removed from the template and read on the Color-Eye; these values were called "Lc."

20. The cleaning efficiency was calculated for each piece using the formula below:

$$\text{Cleaning} = \frac{L_c - L_s}{L_o - L_s} \times 100$$

$$\text{Efficiency} = \frac{L_c - L_s}{L_o - L_s}$$

5

21. Since three carpet pieces were used for each product or formulation, the average of the three cleaning efficiency values was reported.

Dusting Test Procedure

10 This procedure was used to compare the amount residual dust or powder left after cleaning carpet (often known as "frosting").

Materials

Dark colored carpet tiles (available from Milliken & Company, Pattern # 542903)

15 Windsor vacuum cleaner

GretagMacbeth Color-Eye7000A Colorimeter

Preparation

1. A clicking machine was used to cut 4 1/2" x 4 1/2" pieces of light tan commercial grade 18"cut pile carpet tile. Each product or formulation tested was run in triplicate.

20 2. A template was prepared by clicking a 4 1/2" x 4 1/2" piece from the center of a tile. 1/8" of carpet was trimmed from the inside edges of the hole in the template to allow for a good fit.

25 3. Another whole tile was taped to the bottom edge of the template.

25

Procedure

1. A 4 1/2" x 4 1/2" piece of tile was placed into the hole in the template.
2. The GLS machine was used to make 2 passes (up and back) over the template and test carpet.
3. The Windsor vacuum was used to make 5 passes over the template and test carpet.
- 5 Going up and back is considered one pass.
4. Steps 1-3 were repeated for each carpet piece.
5. The LAB values of each carpet piece was measured on the Color-Eye. This reading was recorded as **Lo**.
6. The cleaning composition was then applied to the soiled carpet as described for each
- 10 specific Example above.
7. The piece of carpet was placed in the template.
8. The cleaning formulation was scrubbed into the carpet using 3 passes with the GLS.
9. The carpet was removed from the template and was set aside to dry.
10. The empty template was vacuumed as in Step 3 above.
- 15 11. Steps 12-17 were repeated until all samples had been scrubbed.
12. When the formulation had dried for 30 minutes (or the desired drying time), each piece was placed into the template and 5 passes were made with the Windsor vacuum.
13. The pieces were removed from the template and read on the Color-Eye; these values were called **Lc**.
- 20 14. The relative amount of dusting was calculated for each piece using the formula below:

Dusting Level = $Lc - Lo$ (higher number indicates greater amount of dusting)

- 25 15. Since three carpet pieces were used for each product or formulation, the average of the three cleaning efficiency values was reported.

Examples 10A-10G:**Example 10 – Cleaning Solutions Using Various Dispersion Stabilizing Additives****5 I. Formulations**

A base formulation was first prepared by mixing together the components of Example 10A. Various dispersion stabilizing additives were then added to this base formulation as shown below in Examples 10B-10E. Example 10F did not use this base formulation.

10

Example 10A:

- i. A slurry base formulation was made according to the formulation in Example 5C above.

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Example 10B: Thickened with 0.5% hydroxyethylcellulose (HEC)

- i. To 300 g of the slurry made by the above formulation in Example 10A, 1.5 g of HEC was gradually added and stirred for 30 minutes.
- ii. PH of the final mixture was 8.5 and a stable dispersion was formed.

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Example 10C: 0.5% Kelzan S, a xanthan gum

- i. To 300 g of the slurry made by the above formulation in Example 10A, 1.5 grams of Kelzan S was added and stirred for an hour.
- ii. A stable dispersion was formed.

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Example 10D: 0.5 % Kelzan S

- i. 6 grams of Kelzan S was first dispersed in 294 grams of water and put under a lab homogenizer to mix for 2 minutes.
- ii. 114.7 grams of this Kelzan S solution (i) was blended into 293 grams of the slurry made by the above formulation in Example 5 10A.
- iii. The resultant mixture was a white, uniform stable dispersion.

Example 10E: 1% methacrylic acid / ethyl acrylate copolymer

- i. To 300 g of the slurry made by the above formulation in Example 10A, 3.0 grams of PD-75 (65/35 methacrylic acid/ ethyl acrylate copolymer) was added. PH of the mix was 5-6.
- ii. 50% sodium hydroxide was gradually added until pH was 9.8 and the mix turned somewhat viscous.
- iii. The mix was stirred for 1 hour. A stable dispersion was formed.

15 Example 10F: 2% polyacrylamide

- i. To 300 grams hot tap water was added 6.0 grams of polyacrylamide (Trade Name Cyanatex 695).
- ii. The granules dispersed and the mix was allowed to stir for 1 hour 20 to form a very viscous fluid.
- iii. After the viscosity had developed fully overnight 60 grams of UF polymer was added.
- iv. Then 100 grams of Capture® Spot & Stain remover (available from Milliken and Company) was added and stirred for 30 minutes.

v. A very viscous, white stable dispersion was formed.

II. Test Procedures and Discussion of Results

5 a. The formulation of Example 10C above was placed into a plastic squeeze bottle with plastic bristles. The formulation was squeezed onto a dirty spot on the carpet tiles and brushed in with the bristles. After the product dried, the dirty spot was no longer visible, nor was the dried dispersion.

10 b. The formulation of Example 10C was placed into a trigger spray bottle and was determined to be sprayable through the nozzle. No cleaning evaluation was done with the sprayed composition.

15 c. The formulation of Example 10D above was tested similarly on a larger dirty spot on broadloom carpet. Only part of the spot was treated. After the mixture dried, a white residue was visible where it was applied. After vacuuming the entire spot, the white residue was no longer visible. The treated area was lighter in color, like the clean areas of the rest of the carpet, whereas the untreated area was still dark with stain.

20 d. The formulation of Examples 10A above was tested on fabric to verify that the method of using the inventive cleaning composition does not adversely affect fabrics that will undergo standard laundering processes:

25 i. Testing substrate was 100% cotton oxford flat weave.

ii. Stain medium was burnt motor oil as defined in AATCC Method 130 (Soil Release: Oily Stain Release Method) and the fabric was

stained with three rows of 4 stains each according to the staining procedure.

- iii. One row was treated with the formulation of Example 10A and brushed in and one was left untreated.
- 5 iv. After the row with the formulation of Example 10A was dried, the entire substrate was washed and dried according to the Washing Procedure of AATCC Method 130, using Tide® Quick Dissolving Powder detergent, with a dummy load at 105 degrees F.
- 10 v. The fabric was observed to be free from any defects (fraying, frizzing, disintegrating, etc.) after laundering, indicating that the inventive compositions and methods of cleaning with the compositions may be used on textile substrates such as fabrics, in addition to carpets.
- 15 e. The viscosity profile for the formulation of Example 10D was determined using a Brookfield RVT, spindle #6. The results are shown in Table 10 below.

20 **Table 10 - Viscosity of Example 10D**

RPM	Viscosity (cps)
100	470
50	820
20	1750
10	3100
5	5400
2.5	9200
1	19000

The following Examples are provided to illustrate the differences in drying time and humidity in an area after the carpet in that area has been cleaned. These Examples compare the differences between: Example 11A - cleaning the carpet with Capture® dry powder cleaner, Example 11B - cleaning the carpet using hot water extraction, and

5 Example 11C - cleaning the carpet using the inventive cleaning composition. The results are shown in Table 11 below. The humidity is measured as percent humidity and the temperature is measured in degrees F.

For each Example, an area of carpet measuring 18' x 9.5' was cleaned. The 10 humidity and temperature of the room and of the carpet was recorded before any cleaning was started. An EXTECH Humidity/ Temperature Pen #445580 was placed on a surface 30" above the floor to obtain a reading for the room, and it was placed directly on the carpet to obtain a reading for the carpet. The door to the room remained closed throughout the cleaning session.

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Example 11A – Cleaning procedure for a room using Capture® dry carpet cleaner:

(a) one pound of Capture® was sifted onto the carpet and brushed in by attaching a Capture® brush to a handle (28.59g /m² of Capture® was dispensed on the carpet); and

20 (b) the humidity and temperature readings for the room and carpet were recorded every 15 minutes after cleaning was completed.

Example 11B – Cleaning procedure for a room using hot water extraction (HWE):

25 (a) a Hoover Steam Vac V2 was used to clean the room;

(b) the directions for the steam vac were followed (one forward pass dispensed the chemical, one backward pass rinsed the carpet, and two full passes forward and backward retrieved any remaining liquid);

5 (c) three gallons of water and 15 ounces of steam cleaner chemical were needed to clean the room (713.85g /m² of steam cleaner chemical was dispensed on the carpet); and

(d) the humidity and temperature readings for the room and carpet were recorded every 15 minutes after cleaning was completed.

10 Example 11C – Cleaning procedure for a room using the inventive cleaning composition:

(a) the inventive cleaning composition used above in Example 9A was applied to the carpet throughout the entire room using a trigger sprayer and was then was brushed into the surface of the carpet by attaching a Capture® brush to a handle;

15 (b) 227g of the inventive cleaning composition was applied to the carpet (14.29g/m² of inventive cleaning composition was dispensed on the carpet); and

(c) the humidity and temperature readings for the room and carpet were recorded every 15 minutes after cleaning was completed.

20

Elapsed Time (hour:min)	Ex. 11A Room Humidity (Temp.)	Ex. 11A Carpet Humidity (Temp.)	Ex. 11B Room Humidity (Temp.)	Ex. 11B Carpet Humidity (Temp.)	Ex. 11C Room Humidity (Temp.)	Ex. 11C Carpet Humidity (Temp.)
0:00	17.1 (71.6)	17.1 (71.6)	17.6 (75.5)	17.6 (75.5)	24.9 (71.6)	24.9 (71.6)
0:15	23.2 (72.7)	30.9 (72.7)	56.4 (74.9)	80.2 (74.8)	29.9 (72.4)	30.9 (72.9)
0:30	22.2 (73)	26.7 (73.3)	65 (73.6)	84 (72)	28.2 (73.2)	28.3 (73.9)
0:45	21.8 (72.7)	22.6 (73.3)	55.5 (73.9)	77.5 (73.3)	28.6 (72.6)	28.3 (73)
1:00	19.9 (74.1)	21 (74)	52.4 (73.8)	72.5 (73.4)	26 (73.8)	26 (74)
1:15	20 (73)	20.5 (73.1)	50.2 (73)	73.2 (72.9)	26 (74.1)	26 (74.1)
1:30	20.3 (73.4)	20.5 (73.6)	47.3 (73.3)	74.8 (72.4)	N/a	N/a
1:45	N/a	N/a	45.1 (73.7)	66.5 (73.1)	N/a	N/a
2:00	N/a	N/a	45.1 (73.1)	69.5 (72.6)	N/a	N/a
2:15	N/a	N/a	41.5 (73.7)	67.6 (73.4)	N/a	N/a
2:30	N/a	N/a	41 (73.5)	67.3 (72.8)	N/a	N/a
2:45	N/a	N/a	39.1 (73.8)	56.6 (73.3)	N/a	N/a
3:00	N/a	N/a	39.5 (73.6)	54.2 (73.1)	N/a	N/a
3:15	N/a	N/a	36.9 (74)	47.1 (73.8)	N/a	N/a

"N/a" indicates no data was available.

The results in Table 11 illustrate the advantage of using the inventive cleaning composition, in a slurry or dispersion form, for cleaning carpet. The humidity and 5 temperature recovery times are, by far, much shorter for the inventive cleaning composition of Example 11C than those for the hot water extraction cleaning procedure of Example 11B. This is advantageous because the cleaning cycle time is much shorter due to the ability of the inventive cleaning composition to adequately clean soiled carpet without overwetting the carpet surface, thereby providing a faster dry time. This allows 10 for furniture and other items to be moved back onto the carpet more quickly. The results also illustrate that the inventive cleaning dispersion does not wet the carpet significantly more than the dry carpet cleaner of Example 11A, since humidity and temperature recovery times for both Example 11A and 11C are much more similar to each other than either are to Example 11B.

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Thus, the inventive cleaning composition described herein provides clear textile substrate cleaning advantages over the prior art cleaning systems, such as hot water extraction cleaning systems and dry carpet cleaners. More specifically, and as illustrated by the Examples provided herein, the inventive cleaning composition provides 20 many improvements over the prior art by improving, without limitation,: (a) the convenience of applying a cleaning composition, (b) the cleaning efficiency of the cleaning composition, (c) the time a cleaned textile is wet, and (d) the reduction of the resoil rate caused by residual cleaning composition.

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These and other modifications and variations to the present invention may be practiced by those of ordinary skill in the art, without departing from the spirit and scope of the present invention. Furthermore, those of ordinary skill in the art will appreciate that the foregoing description is by way of example only, and is not intended to limit the scope of 5 the invention described in the appended claims.